

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

(10) International Publication Number
WO 01/38716 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(57) Abstract: An integrated pressure management system (20) manages pressure and detects leaks in a fuel system. The integrated pressure management system also performs a leak diagnostic for the head space in a fuel tank (12), a canister (18) that collects volatile fuel vapors from the head space, a purge valve (16), and all associated.

WO 01/38716 A1

AMENDED CLAIMS

[received by the International Bureau on 15 May 2001 (15.05.01);
new claims 19-76 added; remaining claims unchanged (12 pages)]

15. The integrated pressure management apparatus according to claim 14, further comprising:
a ferrous armature secured to the valve, the ferrous armature being displaced in the displacement direction by the ferrous core.
16. A method of using fluid volume variations for leak detection, the method comprising:
an actuator displacing the device.
17. The leak detection apparatus according to claim 2, wherein the actuator includes a solenoid.
18. The leak detection apparatus according to claim 3, wherein the detector includes a ferrous armature being disposed on the housing and signals] in response to displacement of the device in the chamber.
19. An integrated pressure management apparatus, comprising:
a housing defining an interior chamber, the housing including first and second ports communicating with the interior chamber;
a pressure operable device separating the chamber into a first portion and a second portion, the first portion communicating with the first port, the second portion communicating with the second port, the pressure operable device permitting fluid communication between the first and second ports in a first configuration and preventing fluid communication between the first and second ports in a second configuration;
a signal chamber in fluid communication with the first portion of the interior chamber, the pressure operable device further separating the signal chamber from the second portion of the interior chamber; and
a passageway through the housing, the passageway providing the fluid communication between the first portion of the interior chamber and the signal chamber.
20. The integrated pressure management apparatus according to claim 19, further comprising:

a solenoid displacing the pressure operable device from the first configuration to the second configuration.

21. The integrated pressure management apparatus according to claim 20, wherein the passageway is defined at least in part by a void between the housing and the solenoid.
22. The integrated pressure management apparatus according to claim 19, wherein the passageway includes an opening generally confronting the first port.
23. The integrated pressure management apparatus according to claim 19, wherein the pressure operable device includes a diaphragm separating the signal chamber and the second portion of the interior chamber.
24. The integrated pressure management apparatus according to claim 23, wherein the diaphragm includes a protrusion, and the passageway penetrates the protrusion.
25. The integrated pressure management apparatus according to claim 19, wherein the housing is an assembly of a minimum number of components with seals there between such that a number of possible leak points with respect to the interior chamber is minimized.
26. The integrated pressure management apparatus according to claim 19, further comprising:
a switch signaling displacement of the pressure operable device in response to negative pressure at a first pressure level in the first portion of the interior chamber.
27. The integrated pressure management apparatus according to claim 19, wherein the switch is disposed within the housing.
28. The integrated pressure management apparatus according to claim 27, wherein the switch is generally enclosed by the signal chamber.

29. A housing for an integrated pressure management apparatus, the housing comprising:
an integral homogenous primary body partially defining an interior chamber;
first and second ports communicating with the interior chamber;
a component opening facilitating installation of a pressure operable device into the interior chamber, the pressure operable device separating the interior chamber into a first portion and a second portion, the first portion communicating with the first port, the second portion communicating with the second port, the pressure operable device permitting fluid communication between the first and second ports in a first configuration and preventing fluid communication between the first and second ports in a second configuration; and
a secondary body attachable to the primary body and occluding the component installation opening.
30. The housing according to claim 29, wherein the primary body and the secondary body exclusively enclose the interior chamber having the first and second ports.
31. The housing according to claim 29, further comprising:
a seal member interposed between the primary body and the secondary body, the seal member preventing leakage with respect to the interior chamber.
32. The housing according to claim 29, wherein the pressure operable device includes a diaphragm sealingly interposed between the primary body and the secondary body, the diaphragm separating a signal chamber in fluid communication with the first portion of the interior chamber from the second portion of the interior chamber.
33. The housing according to claim 32, further comprising:
a passageway providing the fluid communication between the first portion of the interior chamber and the signal chamber.
34. The integrated pressure management apparatus according to claim 33, wherein the passageway includes an opening generally confronting the first port.

35. The housing according to claim 29, wherein a volume occupied by the attached primary and secondary bodies is minimized.
36. The housing according to claim 29, further comprising:
a plurality of electrical connections interconnected with a switch disposed in the interior chamber, the switch signaling displacement of the pressure operable device in response to negative pressure at a first pressure level in the first portion of the interior chamber.
37. The housing according to claim 29, wherein the primary body includes a first set of connection features and the secondary body includes a second set of connection features, the first and second set of connection features being interengaged to retain the secondary body with respect to the primary body.
38. The housing according to claim 37, wherein the first and second sets of connection features include unidirectional snap fixtures
39. The housing according to claim 29, further comprising:
an aperture through which the first and second ports communicate in the first configuration, and the pressure operable device includes a poppet occluding the aperture in the second configuration.
40. The housing according to claim 29, wherein the component opening also facilitates installation of a solenoid into the interior chamber, the solenoid displacing the device from the first configuration to the second configuration.
41. The housing according to claim 40, wherein the solenoid includes a stator extending transversely with respect to a displacement direction of the pressure operable device between the first and second configurations.

42. The housing according to claim 40, further comprising:

a passageway providing fluid communication between the first portion of the interior chamber and a signal chamber, the signal chamber is separated from the second portion of the interior chamber by the pressure operable device, and the passageway is defined at least in part by a void between the housing and the solenoid.

43. An integrated pressure management apparatus for a vehicle having an internal combustion engine, the integrated pressure management apparatus comprising:

a housing defining an interior chamber, the housing including first and second ports communicating with the interior chamber;

a pressure operable device separating the chamber into a first portion and a second portion, the first portion communicating with the first port, the second portion communicating with the second port, the pressure operable device permitting fluid communication between the first and second ports in a first configuration and preventing fluid communication between the first and second ports in a second configuration;

a switch signaling displacement of the pressure operable device in response to negative pressure at a first pressure level in the first portion of the interior chamber; and

a solenoid adapted for displacing the device from the first configuration to the second configuration during engine operation and thereby providing a performance diagnostic of the switch.

44. A volatile fuel vapor purge system for an internal combustion engine, the volatile fuel vapor purge system comprising:

a fuel tank having a headspace;

an intake manifold in fluid communication with the headspace;

a charcoal canister in fluid communication with the headspace;

a purge valve having a first side in fluid communication with the intake manifold and having a second side in fluid communication with charcoal canister and with the headspace; and

an integrated pressure management apparatus including:

a housing having an interior chamber in fluid communication with the charcoal canister;

a pressure operable device separating the interior chamber into a first portion and a second portion, the first portion communicating with the charcoal canister, the second portion communicating with a vent port, the pressure operable device permitting fluid communication between the charcoal canister and the vent port in a first configuration and preventing fluid communication between the charcoal canister and the vent port in a second configuration; and

a solenoid adapted for displacing the device from the first configuration to the second configuration during engine operation and thereby providing a performance diagnostic of the purge valve.

45. The volatile fuel vapor purge system according to claim 44, wherein the integrated pressure management apparatus further includes:

a switch signaling displacement of the pressure operable device in response to negative pressure at a first pressure level in the charcoal canister.

46. The volatile fuel vapor purge system according to claim 45, wherein the solenoid is adapted for displacing the device from the first configuration to the second configuration during engine operation and thereby providing a performance diagnostic of the switch.

47. A method of providing a performance diagnostic of a purge valve connecting a charcoal canister to an intake manifold of an internal combustion engine, the method comprising:

providing an integrated pressure management system including:

a housing having an interior chamber in fluid communication with the charcoal canister;

a pressure operable device separating the interior chamber into a first portion and a second portion, the first portion communicating with the charcoal canister, the second portion communicating with a vent port, the pressure operable device permitting fluid communication between the charcoal canister and the vent port in a first configuration and

preventing fluid communication between the charcoal canister and the vent port in a second configuration;

a switch signaling displacement of the pressure operable device in response to negative pressure at a first pressure level in the charcoal canister; and
a solenoid adapted for displacing the pressure operable device from the first configuration to the second configuration;

actuating the solenoid during engine operation to displace the pressure operable device from the first configuration to the second configuration;

evaluating purge valve performance.

48. The method according to claim 47, further comprising:
evaluating switch performance.

49. A fuel system for supplying fuel to an internal combustion engine of a vehicle, the fuel system comprising:

a fuel tank having a headspace;

an intake manifold in fluid communication with the headspace;

a charcoal canister in fluid communication with the headspace;

a purge valve having a first side in fluid communication with the intake manifold and having a second side in fluid communication with charcoal canister and with the headspace;
and

an integrated pressure management system including:

a housing connected to the charcoal canister and defining an interior chamber;

a pressure operable device separating the chamber into a first portion and a second portion, the first portion communicating with the charcoal canister, the second portion communicating with a vent port, the pressure operable device permitting fluid communication between the charcoal canister and the vent port in a first configuration and preventing fluid communication between the charcoal canister and the vent port in a second configuration; and

a switch signaling displacement of the pressure operable device in response to negative pressure at a first pressure level in the charcoal canister.

50. The fuel system according to claim 49, wherein the housing defines an aperture through which the charcoal canister and the vent port communicate in the first configuration, and the pressure operable device includes a poppet occluding the aperture in the second configuration.
51. The fuel system according to claim 49, wherein the housing further defines a signal chamber in fluid communication with the charcoal canister, and the pressure operable device further separates the signal chamber from the second portion of the interior chamber.
52. The fuel system according to claim 49, further comprising:
a minimum number of fluid communication connections.
53. The fuel system according to claim 49, wherein the pressure operable device comprises:
a poppet preventing fluid communication between the charcoal canister and the vent port in the second configuration;
a spring biasing the poppet toward the second configuration; and
a diaphragm separating the second portion of the interior chamber from a signal chamber in fluid communication with the charcoal canister.
54. The fuel system according to claim 53, wherein a negative pressure below the first pressure level displaces the poppet against the spring bias to the first configuration.
55. The fuel system according to claim 53, wherein a positive pressure above a second pressure level in the signal chamber displaces the diaphragm and the poppet against the spring bias to the first configuration.
56. The fuel system according to claim 49, further comprising:
an engine control unit operatively connected to the purge valve; and
a plurality of electrical connections fixed to the housing and adapted to electrically interconnect the switch with the engine control unit.

57. The fuel system according to claim 56, further comprising:
a control circuit disposed in the housing and electrically interconnecting the switch and the plurality of electrical connections.
58. The fuel system according to claim 49, further comprising:
a solenoid displacing the device from the first configuration to the second configuration.
59. The fuel system according to claim 58, wherein the solenoid includes a stator extending transversely with respect to a displacement direction of the device between the first and second configurations.
60. The fuel system according to claim 58, wherein the charcoal canister communicates with a signal chamber via a passage defined at least in part by a void between the housing and the solenoid.
61. The fuel system according to claim 49, further comprising:
a contiguous connection between the charcoal canister and the housing.
62. The fuel system according to claim 61, wherein the contiguous connection is selected from a group consisting of a bayonet connection, a threaded connection, and an interlocking sliding connection.
63. The fuel system according to claim 49, further comprising:
a remote connection extending between the charcoal canister and the housing spaced from the charcoal canister.
64. The fuel system according to claim 63, wherein the remote connection is selected from a group consisting of a rigid pipe and a flexible pipe.

65. A fuel system, comprising:

a leak detector sensing negative pressure at a first pressure level in a headspace of a fuel tank, a charcoal canister, and fluid conduits interconnecting the fuel tank and charcoal canister; and

a pressure operable device operatively connected to the leak detector, the pressure operable device relieving negative pressure below the first pressure level and relieving positive pressure above a second pressure level.

66. A method of managing pressure in a fuel system including a fuel tank, a charcoal canister, and fluid conduits interconnecting the fuel tank and charcoal canister, the method comprising:

providing an integrated assembly including a switch actuated in response to the pressure and a valve actuated to relieve the pressure; and

signaling with the switch a negative pressure at a first pressure level.

67. The method according to claim 66, further comprising:

actuating the valve to relieve negative pressure below the first pressure level.

68. The method according to claim 66, further comprising:

actuating the valve to relieve positive pressure above a second pressure level.

69. A method of calibrating an integrated pressure management apparatus, the method comprising:

providing a chamber having an interior volume varying in response to fluid pressure in the chamber, the chamber including a diaphragm displaceable between a first configuration in response to fluid pressure above a certain pressure level and a second configuration in response to fluid pressure below the certain pressure level;

providing a resilient element applying a force biasing the diaphragm toward the first configuration;

providing a switch actuated by the diaphragm in the second configuration;
connecting the chamber to a pressure source at the certain pressure level; and

adjusting the biasing force such that the switch is actuated at the certain pressure level.

70. The method of calibrating according to claim 69, further comprising:
providing an adjuster contiguously engaging the resilient element.
71. The method of calibrating according to claim 70, wherein the adjusting includes operating the adjuster to modify the biasing force.
72. The method of calibrating according to claim 70, wherein the providing an adjuster includes providing a calibrating screw threadably mounted with respect to the chamber, and the adjusting includes turning the calibrating screw.
73. The method of calibrating according to claim 72, wherein the providing a resilient element includes providing a leaf spring having a first end fixed with respect to the chamber and a second end contiguously engaging the diaphragm, and the adjusting includes turning the calibrating screw in contiguous engagement with an intermediate portion of the leaf spring between the first and second ends.
74. The method of calibrating according to claim 72, wherein the providing a resilient element includes providing a leaf spring having a first end fixed with respect to the housing and the calibrating screw connecting a second end of the leaf spring with respect to the chamber, and the adjusting includes turning the calibrating screw to adjust spacing between the first and second ends.
75. The method of calibrating according to claim 69, further comprising:
iterating the connecting the chamber to the pressure source and the adjusting the biasing force until the switch is actuated at the certain pressure level.

76. The method of calibrating according to claim 75, further comprising:
disconnecting the chamber from the pressure source between iterations of the
adjusting the biasing force.

